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(54) Title: A POWDERED PROTEIN COMPOSITION HAVING BINDING PROPERTIES ADAPTED FOR USE AS PROTEIN SOURCE AND BINDER IN A FORMULATED FEED

(57) Abstract

A powdered protein composition which has a protein content of above 35 % by weight and which in formulated feed functions both as a protein source and as a binder comprises a matrix of protein containing particles of animal and/or vegetable origin and/or single cell protein, upon which a protein hydrolysate is dried. Production of the protein composition is described.

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A powdered protein composition having binding properties adapted for use as protein source and binder in a formulated feed.

The present invention relates to a powdered protein composition which has a protein content of above 35% and which in formulated feed functiones both as protein source and binder.

The invention also relates to a process for producing the protein composition.

Breeding of fish and other marine organisms increases to high extent, and the need for formulated feed is increasing. Compared to feed for ordinary domestic animals such a feed has a relatively high content of protein. An increasing part of the world's production of fish meal is used in formulated fish feed, in the form of pellets, and vegetable protein ingredients, single cell protein and other animal protein ingredients are incorporated as supplement. Earlier such feed contained considerable amounts of carbohydrates or other binders which provide a feed pellet having adequate strength, but which have low nutritive value. The development has proceeded towards a feed with a high energy level, and it is therefore less possibility for using binders having a low nutritive value, and problem arises because the feed pellet thus not have enough strength to resist the treatment it is exposed to during processing, storage and the transport.

One of the main ingredients in fish feed is fish meal, and the strength of the feed pellet is to a great extent determined by the physical properties of the fish meal,

which will vary with fish species, fishing season and the conditions during processing in the fish meal factory.

Fish silage is in the literature first mentioned by Swedish researches (H. Edin, (1940): Nord. Jordbr. Forsk., Vol 22, p 142. - N. Olsson (1942): Landbrukshøgskolans Husdjursforsøksanstalt (1942), Report No. 7). Later a great number of articles have been published (Examples: I. Tatterson, in "Proc. of the Torry Res. Station Symp. on Fish Silage", Aberdeed (1976), p 1-10. - A. Gildberg, J. Raa (1979): Comp. Biochem. Physiol., 63B, p 309.- D. Potter, I. Tatterson, J. Wignall in "Advances in Fish Science and Technology" (ed. J.J. Connell), Fishing News Books Ltd. (1980), p 338-343).

The fish silage is produced by grinding fish or parts of fish, and adding acid, usually formic acid, to a pH of 3.5 - 4. The ground fish can thereby be stored without bacterial decomposition, but the fish's own enzymes will cause a hydrolysis of the proteins to peptides and amino acids (S. Vecchi, Z. Coppes (1996): J. Food Biochem., Vol 20, p 193-214). Another, similar hydrolysate can be prepared in that proteinuous material, such as animal or vegetable protein or single cell protein, is treated with proteolytic enzymes in a manner known per se (J. Adler-Nissen "Enzymatic Hydrolysis of Food Proteins", Elsevier Applied Science Publishers, Ltd., 1986, G. Søbstad: "Meldinger fra SSF", No. 2, p 11-14, 1980 - F. Jacobsen, O. Lykke-Rasmussen: Process Biochem, 1984, p 165-169). The degree of hydrolysis can be determined in different ways, but is often defined as the percentage of protein (nitrogen x 6.25) which is not precipitated in water to which is added 5% trichloric acetic acid, i.e. that a degree of hydrolysis of 50% means that 50% of the protein is soluble in water which contains 5% trichloric acetic acid.

Industrial processes are known where raw fish silage is heated and oil separated before the fish silage is concentrated by evaporation to a solid content of 30 -50% (B. Stormo, T. Strøm: "Ensilering av fiskeslo", FTFI-report no. 663.2-4-3, Fiskeriforskning, Tromsø, December 1978).

Both raw ensilage and fish silage concentrate are used as raw material for the production of feed for domestic animals and fish (F.E. Stone, (1989) Aquaculture, Vol 76 (1-2) p 109-118. - D. Manikandavelu, et al. (1992) Fish Technol., Vol 29 (2) p 111-113).

During the ensilaging process there will be a partial decomposition of some important amino acids (A. Gildberg, J. Raa: J. Sci. Food Agric., Vol 28, 1977, p 647). For animals with a high nutritive need, for example fish, the fish silage therefore should be used together with another valuable protein source, for example fish meal.

Protein hydrolysates have good binding properties in formulated feed and contribute in obtaining a feed pellet having the desired strength. With exception of the fish oil most of the raw materials which are used in such feed are present in the dry form, and for the process it would be an advantage if also the protein hydrolysate would be present as powder. Protein hydrolysate has a high content of ingredients with glue properties and will in dry form therefore appear as a hygroscopic powder with poor powder properties.

Mixing of such a powder into a feed blend is problematic.

An object of the present invention is to provide a protein composition which does not cause the problems mentioned above and which yield a feed pellet having adequate strength and a high energy content.

Further there is an object of the invention to provide a process for producing the protein composition.

These objects are obtained by the characterising features in claim 1 and claim 9, respectively.

Examples of matrix are press cake from the fish meal process, fish meal, meat/bone meal, soya meal, etc. It is thereby obtained protein compositions which in addition to good nutritive properties also have adequate powder technical properties, and, used in formulated feed, provide a pellet having adequate strength without use of other binders. Further, it has been shown that such protein

compositions can be used as binders during production of formulated feed wherein other raw materials yield poor binding properties.

The invention will be illustrated by means of the following examples with reference to the accompanying drawings, which show correlation between the amount of hydrolysate used and the properties of the composition which has been prepared.

Example 1

Feed pellets were prepared from two fish meals (F1 and F2), produced in the same factory from the same fish material, without and with addition of fish silage. F2 was produced by substituting 10% of the raw material to the cooker with fish silage. Dry feed mass introduced into the extruder contained 76% by weight of either F1 or F2. The feed mass also contained 19% by weight wheat meal. The fat content of the feed mass was adjusted to 11% by weight with fish oil before extrusion. Extrusion was carried out under similar conditions and with a 7 mm die opening. Feed pellets, A1 from feed mass containing F1 and A2 from feed mass containing F2, were dried to a water content of 7% by weight.

The following table shows comparison of physical quality of pellet from the two feed mixtures. Analysis of dried pellet was carried out before addition of oil to desired final level to obtain a higher fat level, for example up to 30 - 40%.

Feed pellet no.:	Pneumatic durability (%)	Hardness (kp)
A1	64	5.6
A2	80	9.7

Pneumatic durability is determined by a standardised method for simulated, pneumatic transport and state % of the part of the pellet which has not been crushed.

The figures for pneumatic durability show that the feed pellet from fish meal F2 has a higher strength and resist pneumatic transport better than the feed pellet from fish meal from F1.

Example 2

Feed pellets were prepared from two fish meals F3 and F4 containing different amounts of hydrolysed stick water protein as fish hydrolysate. The meals were produced in the same factory from the same fish raw material. F4 contained the double amount hydrolysed stick water protein compared to F3. The feed mass added to the extruder contained either F3 or F4. F3 contained 8.5% by weight hydrolysed protein, based on dry feed mass, and F4 contained 15.7% by weight. Otherwise the feed mass had the same content of other ingredients and was extruded/dried as described in example 1. Feed pellets produced, A3 from feed mass containing F3 and A4 from feed mass containing F4, where compared concerning physical quality. The analysis were carried out on dried pellet after addition of fish oil to desired final level.

Feed pellet no.:	Pneumatic durability (%)	Hardness (kp)
A3	0	1
A4	95	9.6

The figures show that feed pellet from F3 has a lower strength and does not resist pneumatic transport. Both strength and pneumatic durability are dramatically improved for feed pellet from F4.

Example 3

Based on fish raw material, namely stick water from the fish meal process, three fractions having different content of hydrolysed protein were produced:

P1: Stick water fraction containing 31% hydrolysed protein.

P2: Stick water fraction having 48% hydrolysed protein.

P3: Stick water fraction having 90% hydrolysed protein.

Starting with a fish meal (F5) and those three stick water fractions mentioned above 4 fish meals were prepared:

F5: Fish meal, 100%

F6: F5 containing P1 in the ratio 91.5% : 8.5%.

F7: F5 containing P2 in the ratio 91.5% : 8.5%.

F8: F5 containing P3 in the ratio 91.5% : 8.5%.

The feed mass introduced into the extruder contained either F5, F6, F7 or F8. F6 contained 9.1% of hydrolysed protein based on dried feed mass, F7 contained 9.7% by weight, and F8 contained 11% by weight. Otherwise the feed masses had an equal content of other ingredients and were extruded/dried as described in example 1. Feed pellets, A5, A6, A7 and A8 from feed masses containing F5, F6, F7 and F8 respectively, were compared what physical quality concerns. The analysis were carried out on dried pellet before addition of oil to desired final level.

Feed pellet no.:	Pneumatic durability (%)	Stability in water (%)
A5	0	74
A6	59	82
A7	69	84
A8	92	88

It appears from the table that the strength of the feed pellets, expressed by pneumatic durability, and the stability of the pellets in water increase with increasing addition of hydrolysed protein. If both pneumatic durability and stability in water were plotted as the

function of the amount of hydrolysed protein introduced into the extruder for A6, A7 and A8, respectively, a linear correlation as shown in figures 1 and 2, respectively, is obtained.

Example 4

A binder based on protein was prepared by drying fish silage on a matrix of fish meal. The binder (P4) contained 42% by weight fish silage, based on solid content. By mixing fish meal (F9) and binder (P4) the following 5 fish meals were prepared:

F9: Fish meal, 100%.
F10: F9 containing P4 in the ratio 99.1% : 0.9%.
F11: F9 containing P4 in the ratio 98.3% : 1.7%.
F12: F9 containing P4 in the ratio 96.6% : 3.4%.
F13: F9 containing P4 in the ratio 91.4% : 8.6%.

The feed mass introduced into the extruder contained either F9, F10, F11, F12 or F13. Otherwise the feed mass had the same content of other ingredients and was extruded/dried as described in example 1. The pellets, A9, A10, A11, A12 and A13 produced from feed mass containing F9, F10, F11, F12 and F13 respectively, were compared concerning physical quality. The analysis were carried out on dried pellet before addition of oil to desired final level.

Feed pellet no.:	Mechanical durability (%)	Stability in water (%)
A9	52.2	77.5
A10	57.2	79.9
A11	60.8	80.2
A12	62.8	80.9
A13	80	84.4

Mechanical durability is determinated according to a standardised method for simulating transport in bulk.

The durability of the pellets, expressed as mechanical durability, and the stability of the pellets in water increase with increasing addition of binder P4. If both mechanical durability and stability in water are plotted as the function of the amount of P4 introduced into the extruder for A9, A10, A11, A12 and A13 a linear correlation as shown in figures 3 and 4 is obtained.

C L A I M S.

1. Powdered protein composition which has a protein content of above 35% by weight and which in formulated feed functions both as a source of protein and as a binder, c h a r a c t e r i z e d i n t h a t it comprises a matrix of protein containing particles of animal and/or vegetable origin and/or single cell protein, upon which a protein hydrolysate has been dried.

2. Protein composition in accordance with claim 1, c h a r a c t e r i z e d i n t h a t the matrix comprises fish meal and/or press cake for preparing fish meal.

3. Protein composition in accordance with claim 1, c h a r a c t e r i z e d i n t h a t the matrix comprises meat/bone meal.

4. Protein composition in accordance with any of claims 1-3, c h a r a c t e r i z e d i n t h a t the matrix comprises meal of soya, raps, or other vegetable protein, or single cell protein, or mixtures thereof, having a protein content of at least 35% by weight.

5. Protein composition in accordance with any of the preceding claims, c h a r a c t e r i z e d i n t h a t the protein hydrolysate is prepared by hydrolysis of animal and/or vegetable protein and/or single cell protein.

6. Protein composition in accordance with claim 5, c h a r a c t e r i z e d i n t h a t the protein hydrolysate is fish silage, either in raw or concentrated form.

7. Protein composition in accordance any of the preceding claims, characterized in that the protein hydrolysate has a degree of hydrolysate of at least 50% by weight.

8. Protein composition in accordance any of the preceding claims, characterized in that the protein from the protein hydrolysate comprises 5 - 95% by weight of the solid content of the protein composition.

9. Process for preparing a powdered prote in composition which has a protein content of above 35% by weight and which in formulated feed functions both as a source of protein and as a binder, characteriz ed in that a protein hydrolysate in liquid form is dried on a matrix of particles of animal or vegetable origin and/or of single cell protein.

10. Process in accordance with claim 9, charac - terized in that as a protein hydrolysate is used fish silage, hydrolysed fish protein, single cell protein, vegetable protein or a mixture thereof.

Figure 1.

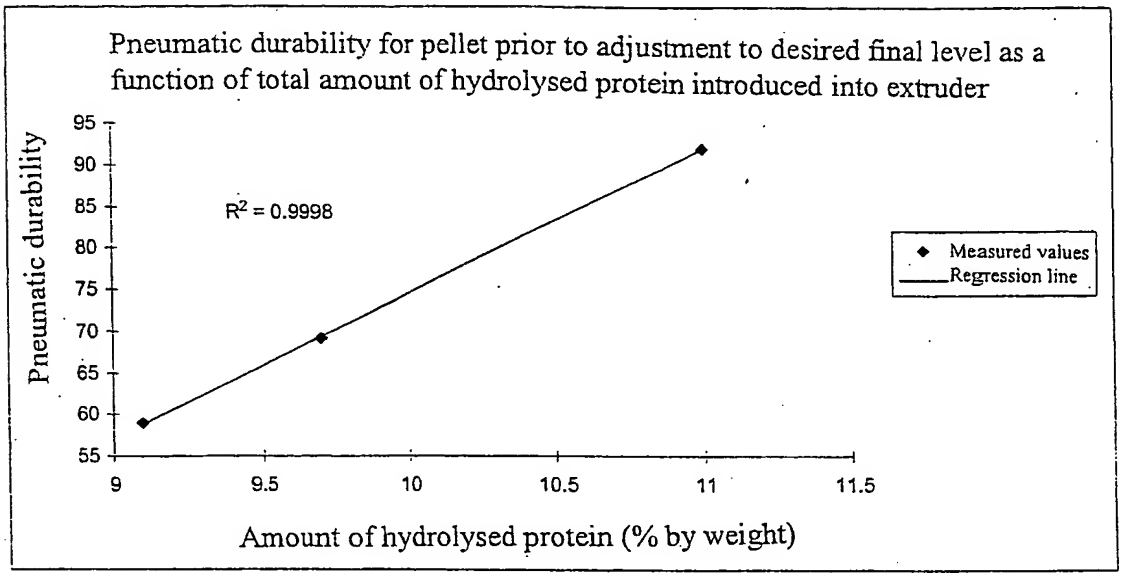


Figure 2.

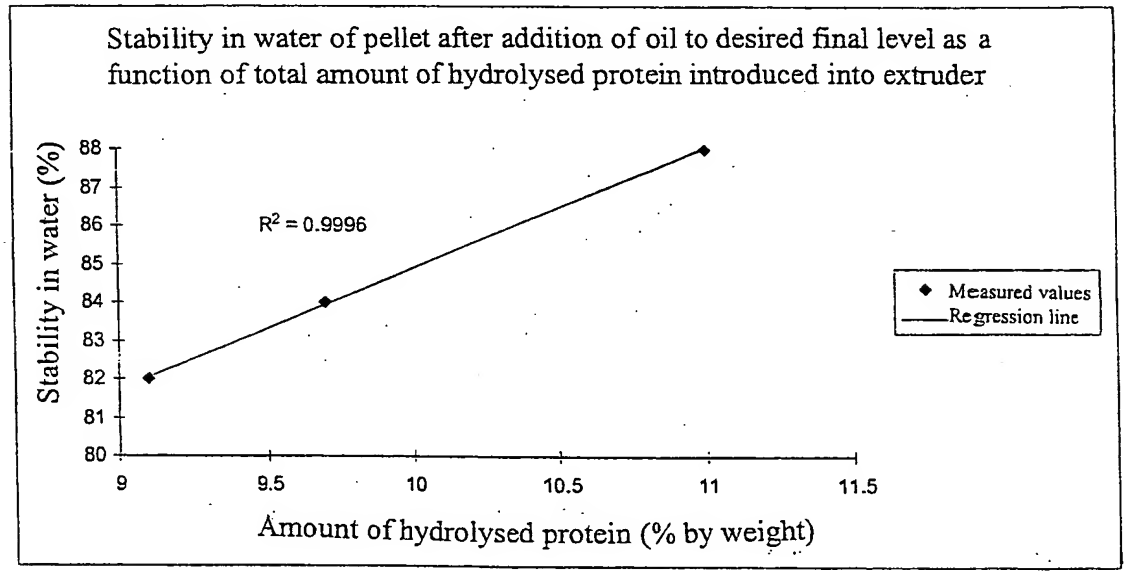


Figure 3.

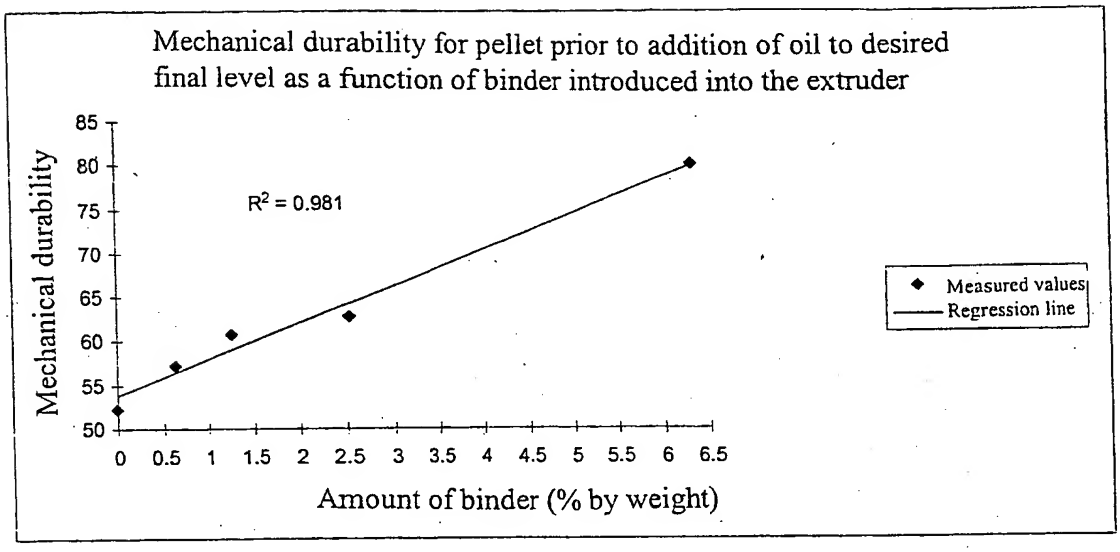
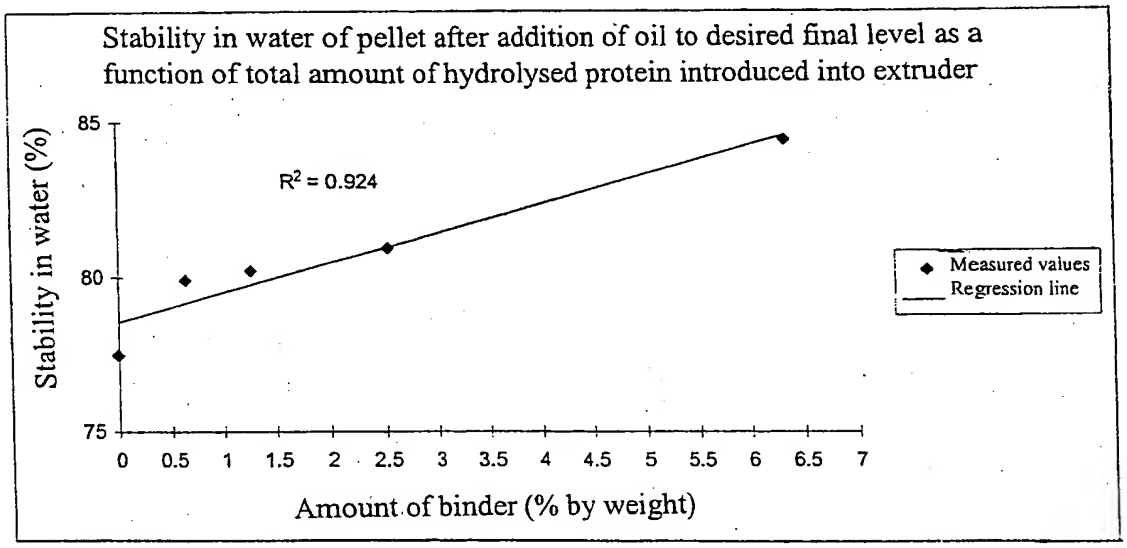


Figure 4.



INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 99/00385

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A23K 1/00, A23J 1/18, A23J 1/20
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A23K, A23J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	File WPI, Derwent accession no. 1985-272846, AJINOMOTO GENERAL FOODS INC: "Improving desirability of dry and semi-dry pet foods - by incorporating crab metal and protein hydrolysate"; & JP,A,60184360, 19850919 DW198544	1-10
X	GB 2247604 A (DIELEN LABORATORIES), 11 March 1992 (11.03.92)	1-10
A	FR 2542013 A1 (BIO-INDUSTRIES), 7 Sept 1984 (07.09.84)	1-10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 3697285 A (WILLIAM T. FAITH), 10 October 1972 (10.10.72) --	1-10
A	US 4764383 A (SHERWIN R. BROWN ET AL), 16 August 1988 (16.08.88) --	1-10
A	WO 8704051 A1 (PETROFF, PAUL), 16 July 1987 (16.07.87) -- --------	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
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